Indiana Department of Education
Academic Standards Course Framework

DIGITAL ELECTRONICS

Digital Electronics is a course of study in applied digital logic that encompasses the design and application of electronic circuits and devices found in video games, watches, calculators, digital cameras, and thousands of other devices. Instruction includes the application of engineering and scientific principles as well as the use of Boolean algebra to solve design problems. Using computer software that reflects current industry standards, activities should provide opportunities for students to design, construct, test, and analyze simple and complex digital circuitry software will be used to develop and evaluate the product design. This course engages students in critical thinking and problem-solving skills, time management and teamwork skills.

- DOE Code: 4826
- Recommended Grade Level: Grade 10-12
- Recommended Prerequisites: Introduction to Engineering Design, Principles of Engineering
- Credits: 1 credit per semester, maximum of 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas
- This course is aligned with postsecondary courses for Dual Credit
    - Ivy Tech
        - EECT 112 Digital Fundamentals (pending)
    - Vincennes University
        - ELEC 130 - Digital Logic I

Dual Credit

This course provides the opportunity for dual credit for students who meet postsecondary requirements for earning dual credit and successfully complete the dual credit requirements of this course.

Application of Content and Multiple Hour Offerings

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences.

Content Standards

Domain – Lab and Electrical Wiring Safety

Core Standard 1 Students apply concepts of lab and electrical wiring safety to ensure a safe work environment.

Standards

DE-1.1 Demonstrate the use of wearing safety attire

DE-1.2 State the safety purposes of properly handling materials such as solder, batteries

DE-1.3 Identify the causes of and dangers of electric shock and explain the methods to prevent it

DE-1.4 Design electronic circuits that involve the environmental concerns with creating safe circuits

Domain – Basic Laws of Electricity

Core Standard 2 Students evaluate the basic laws of electron theory and electricity in reference to

solving parallel and series circuits.

Standards

DE-2.1 Design circuit boards that integrate parallel circuits

DE-2.2 Design circuit boards that integrate series circuits

DE-2.3 Calculate Ohm's Law to for simple series and parallel circuits

DE-2.4 Identify and label the parts of an atom and what elements are good conductors, insulators, and semiconductors

DE-2.5 Explain Quantum energy in relationship to electrons classified as insulators or conductors

DE-2.6 Calculate Kirchhoff's Voltage Law for simple series and parallel circuits

DE-2.7 Calculate Kirchhoff's Current Law for simple series and parallel circuits

DE-2.8 Define and explain Alternating Current and Direct Current

Domain – Electrical Components

Core Standard 3 Students apply concepts of the basic electrical components to design and create.

Standards

DE-3.1 Summerize the material makeup of resistors and how they are used in circuit design

DE-3.2 Relate the symbols associated with resistors and how they function

DE-3.3 Calculate tolerance levels of various resistors to determine if the measured value is within specifications

DE-3.4 Analyze the component parts of a capacitor and how it holds a static charge

DE-3.5 Identify and describe the units of measurements for capacitors

DE-3.6 Calculate the values of capacitors and their voltage polarity requirements

DE-3.7 Distinguish the different types of capacitors and their voltage polarity requirements

Domain – Digital Logic Circuits

Core Standard 4 Students create and analyze digital logic circuits for knowledge, accuracy and efficiency.

Standards

DE-4.1 Recognize the relationship between the Boolean expression, logic diagram, and the truth table

DE-4.2 Design Boolean Expressions, logic circuit diagrams or truth tables from information provided in the solution of design problems

DE-4.3 Select the Sum-of Products or the Products-of-Sums form of a Boolean Expression to use in the solution of a problem

DE-4.4 Apply the rules of Boolean algebra to logic diagrams and truth tables to minimize the circuit size necessary to solve a design problem

DE-4.5 Demonstrate DeMorgan's to simplify a negated expression and to convert a SOP to a POS and visa versa in order to same resources in the production of circuits

DE-4.6 Formulate and employ a Karnaugh Map to reduce Boolean expressions and logic circuits to their simplest forms

DE-4.7 Create circuits to solve a problem using NAND or NOR gates to replicate all logic functions

DE-4.8 Apply their understanding of the workings of NOR and NAND gates to make comparisons with standard combinational logic solutions to determine amount of

resource reduction

DE-4.9 Use schematics and symbolic Algebra to represent digital gates in the creation of solutions to design problems

DE-4.10 Identify the name, symbol, and function and create truth tables and Boolean Expression for the basic logic gates through research and experimentation

DE-4.11 Apply logic to design and create, using gates, solutions to a problem

DE-4.12 Assemble circuits and compile information about the various applications of flip-flops

Domain – AC Waveforms and AC Voltage Generation

Core Standard 5 Students analyze the characteristics of AC waveforms and AC voltage generation to validate signals.

Standards

DE-5.1 Analyze a digital waveform and identify the anatomy of the waveform

DE-5.2 Differentiate between digital and analog signals when given the waveforms

DE-5.3 Design, create and test circuits

DE-5.4 Calculate the output frequency of circuits using observations and the oscilloscope

Domain – Single and Three Phase AC Power

Core Standard 6 Students analyze single and three phase AC power to understand the single versus three phase systems.

Standards

DE-6.1 None

Domain – Soldering, Equipment, Supplies

Core Standard 7 Students will establish a working and functional knowledge of the software and equipment used in designing and troubleshooting circuits.

Standards

DE-7.1 Create circuits using circuit design software

DE-7.2 Test circuit/measure values using a Digital Multi-Meter

DE-7.3 Demonstrate successful soldering and desoldering techniques

DE-7.4 Demonstrate breadboarding techniques

DE-7.5 Identify the appropriate tools for working on circuit systems using safety guidelines

Domain – Number Systems, Simplifying

Core Standard 8 Students will convert and calculate number systems and sequences to work with large numbers, small numbers, and simplify problems.

Standards

DE-8.1 Convert numbers between the binary and decimal number systems

DE-8.2 Translate design specifications into truth tables

DE-8.3 Construct truth tables from logic expressions

DE-8.4 Understand numerical place value

DE-8.5 Use mathematical symbols to represent bases and will communicate concepts using different number systems

DE-8.6 Demonstrate the relationship of binary and hexadecimal to bits and bytes of information used in computers

DE-8.7 Convert values from one number systems to another

DE-8.8 Design, construct and test adder circuits using both discrete and MSI gates

DE-8.9 Re-write any number using conventional prefix definitions

DE-8.10 Demonstrate understanding of binary addition and subtraction

DE-8.11 Create and prove truth tables

Domain – Microprocessors

Core Standard 9 Students design and create a microprocessor to understand the full impact of design, creation and implementation of a processor.

Standards

DE-9.1 Formulate to flow chart to correctly apply basic programming concepts in the planning of a project

DE-9.2 Design and create a program, using correct syntax, to evaluate data and make decisions based on information gathered from the environment using external digital and analog sensors

Process Standards

Common Core Literacy Standards for Technical Subjects

Reading Standards for Literacy in Technical Subjects 9-10

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Key Ideas and Details

9-10.RT.1 Cite specific textual evidence to support analysis of technical texts, attending to the precise details of explanations or descriptions.

9-10.RT.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

9-10.RT.3 Follow precisely a complex multistep procedure when performing technical tasks, attending to special cases or exceptions defined in the text.

Craft and Structure

9-10.RT.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to *grades 9-10 texts and topics*.

9-10.RT.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).

9-10.RT.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Idea

9-10.RT.7 Translate technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

9-10.RT.8 Assess the extent to which the reasoning and evidence in a text support the author's

claim or a recommendation for solving a technical problem.

9-10.RT.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Range of Reading and Level of Text Complexity

9-10.RT.10 By the end of grade 10, read and comprehend technical texts in the grades 9-10 text complexity band independently and proficiently

Writing Standards for Literacy in Technical Subjects 9-10

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Text Types and Purposes

9-10.WT.1 Write arguments focused on *discipline-specific content*.

9-10.WT.2 Write informative/explanatory texts, including technical processes.

9-10.WT.3 Students will not write narratives in technical subjects. *Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In technical, students must be able to write precise enough descriptions of the step-by-step procedures they use in their technical work that others can replicate them and (possibly) reach the same results.*

Production and Distribution of Writing

9-10.WT.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

9-10.WT.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

9-10.WT.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

9-10.WT.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

9-10.WT.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectivity to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation

9-10.WT.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

9-10.WT.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific

tasks, purposes, and audiences.

Career and Technical Student Organizations

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in a Career and Technical Student Organization, such as SkillsUSA.